

Claims

- 1 1. Motor vehicle electric system comprising an internal combustion engine and,  
2 mechanically connected thereto, an integrated starter-generator that charges a double  
3 layer capacitor and a battery to a first voltage via a bi-directional AC/DC converter in  
4 generator mode and is driven by the energy stored in the double layer capacitor or in  
5 the battery in motor mode, wherein an intermediate circuit capacitor is arranged  
6 between the positive and negative direct voltage terminals of the bi-directional AC/DC  
7 converter, a first switch is provided via which the positive direct voltage terminal of  
8 the bi-directional AC/DC converter can be connected to the plus pole of the battery,  
9 the minus pole of which is grounded, and a second switch is provided via which the  
10 positive direct voltage terminal of the bi-directional AC/DC converter can be  
11 connected to the positive terminal of the double layer capacitor, the negative terminal  
12 of which is grounded.
- 1 2. Motor vehicle electric system according to Claim 1, wherein the first and  
2 second switches are interlinked in such a way that they cannot both be in the  
3 conducting position at the same time.
- 1 3. Motor vehicle electric system according to Claim 1, wherein the intermediate  
2 circuit capacitor can be charged from the AC/DC converter to a voltage value  
3 corresponding to the voltage at the double layer capacitor or the battery before the first  
4 or second switch is switched to the conducting position.
- 1 4. Motor vehicle electric system according to Claim 1, wherein the flow of  
2 current into the AC/DC converter or out of the AC/DC converter can be reduced to a  
3 minimal value before the first or second switch is switched to the non-conducting  
4 position.

1 5. Motor vehicle electric system according to Claim 1, wherein a regulator circuit  
2 is provided by means of which the double layer capacitor can be recharged from the  
3 battery.

1 6. Motor vehicle electric system according to Claim 1, wherein the double layer  
2 capacitor is charged to an elevated voltage higher than the voltage of the battery.

1 7. Motor vehicle electric system according to Claim 1, comprising an additional  
2 battery to supply additional loads with a second voltage, which additional battery is  
3 charged via a bi-directional DC/DC converter by the battery, wherein a third switch is  
4 provided via which the plus pole of the first battery can be connected to a positive  
5 terminal of the bi-directional DC/DC converter, and a fourth switch is provided via  
6 which the positive terminal of the double layer capacitor can be connected with the  
7 same positive terminal of the bi-directional DC/DC converter.

1 8. Motor vehicle electric system according to Claim 7, wherein the third and  
2 fourth switches are interlinked in such a way that they cannot both be in the  
3 conducting position at the same time.

1 9. Motor vehicle electric system according to Claim 1, comprising a  
2 control/regulation circuit for controlling /regulating operations from the group of  
3 - charging the intermediate circuit capacitor via the AC/DC converter to a voltage  
4 value corresponding to the voltage at the double layer capacitor or the 36 V  
5 battery,  
6 - determining the working direction of the converters (step-up or step-down), and  
7 - controlling the positions of switches S1 to S4.

- 1    10.    Motor vehicle electric system according to Claim 1, wherein  
2    -    when the integrated starter-generator is in generator mode:  
3        - the intermediate circuit capacitor is charged to a predefinable voltage when the  
4           switches are non-conducting,  
5        - the battery is charged when the first switch is conducting and  
6        - the double layer capacitor is charged when the second switch is conducting and  
7    -    when the integrated starter-generator is in motor mode:  
8        - the starter-generator is driven with energy from the battery when the first  
9           switch is conducting and  
10       - the starter-generator is driven with energy from the double layer capacitor  
11           when the second switch is conducting.

- 1    11.    Motor vehicle electric system according to claim 7, wherein  
2    -    the battery charges or is charged by the additional battery when the third switch  
3        is conducting and  
4        - the double layer capacitor charges or is charged by the additional battery when  
5           the fourth switch is conducting.

- 1    12.    Motor vehicle electric system according to claim 8, wherein  
2    -    the battery charges or is charged by the additional battery when the third switch  
3        is conducting and  
4    -    the double layer capacitor charges or is charged by the additional battery when  
5        the fourth switch is conducting.

1 13. Method of operating a motor vehicle electric system comprising an integrated  
2 starter-generator comprising the steps of:  
3 - charging a double layer capacitor and a battery to a first voltage via a bi-directional  
4 AC/DC converter in a generator mode,  
5 - driving the starter-generator by the energy stored in the double layer capacitor or in  
6 the battery in a motor mode,  
7 - arranging an intermediate circuit capacitor between the positive and negative direct  
8 voltage terminals of the bi-directional AC/DC converter,  
9 - providing a first switch via which the positive direct voltage terminal of the bi-  
10 directional AC/DC converter can be connected to the plus pole of the battery, the  
11 minus pole of which is grounded, and  
12 - providing a second switch via which the positive direct voltage terminal of the bi-  
13 directional AC/DC converter can be connected to the positive terminal of the double  
14 layer capacitor, the negative terminal of which is grounded.

1 14. Method according to Claim 13, further comprising the step of interlinking the  
2 first and second switches in such a way that they cannot both be in the conducting  
3 position at the same time.

1 15. Method according to Claim 13, further comprising the step of charging the  
2 intermediate circuit capacitor from the AC/DC converter to a voltage value  
3 corresponding to the voltage at the double layer capacitor or the battery before the first  
4 or second switch is switched to the conducting position.

1 16. Method according to Claim 13, further comprising the step of reducing the  
2 flow of current into the AC/DC converter or out of the AC/DC converter to a minimal  
3 value before the first or second switch is switched to the non-conducting position.

1 17. Method according to Claim 13, further comprising the step of recharging the  
2 double layer capacitor from the battery by a regulator circuit.

1 18. Method according to Claim 13, further comprising the step of charging the  
2 double layer capacitor to an elevated voltage higher than the voltage of the battery.

1 19. Method according to Claim 13, further comprising the steps of:  
2 - charging an additional battery via a bi-directional DC/DC converter by the battery,  
3 - providing a third switch via which the plus pole of the first battery can be connected  
4 to a positive terminal of the bi-directional DC/DC converter, and  
5 - providing a fourth switch via which the positive terminal of the double layer  
6 capacitor can be connected with the same positive terminal of the bi-directional  
7 DC/DC converter.

1 20. Method according to Claim 19, further comprising the step of interlinking the  
2 third and fourth switches in such a way that they cannot both be in the conducting  
3 position at the same time.

1 21. Method according to Claim 13, further comprising the step of controlling  
2 /regulating operations from the group of:  
3 - charging the intermediate circuit capacitor via the AC/DC converter to a voltage  
4 value corresponding to the voltage at the double layer capacitor or the 36 V  
5 battery,  
6 - determining the working direction of the converters (step-up or step-down), and  
7 - controlling the positions of switches S1 to S4.

1    22.    Method according to Claim 13, further comprising the steps of  
2    -    when the integrated starter-generator is in generator mode:  
3        - charging the intermediate circuit capacitor to a predefinable voltage when the  
4           switches are non-conducting,  
5        - charging the battery when the first switch is conducting and  
6        - charging the double layer capacitor when the second switch is conducting and  
7    -    when the integrated starter-generator is in motor mode:  
8        - driving the starter-generator with energy from the battery when the first switch  
9           is conducting and  
10       - driving the starter-generator with energy from the double layer capacitor when  
11           the second switch is conducting.

1    23.    Method according to Claim 19, further comprising the step of  
2    -    the battery charges or is charged by the additional battery when the third switch  
3        is conducting and  
4    -    the double layer capacitor charges or is charged by the additional battery when  
5        the fourth switch is conducting.

1    24.    Method according to Claim 20, further comprising the step of  
2    -    the battery charges or is charged by the additional battery when the third switch  
3        is conducting and  
4    -    the double layer capacitor charges or is charged by the additional battery when  
5        the fourth switch is conducting.